Convergence between the business cycles of New European Member States and the "Euro" business cycle

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Abstract:

The Optimal Currency Area (OCA) theory states that countries are more suited to belong to a monetary union when they meet certain criteria related to the real convergence of an economy: a high degree of external openness, mobility of factors of production and diversification of production structures. According to this theory, if there is a clear convergence between business cycles of countries that are willing to join the monetary union and the business cycle within the currency area, then this tends to prove that these countries are ready to enter the currency area. In particular, in this paper, we are testing this hypothesis in order to determine whether new European member states are ready to join the euro area; first, we shall present a literature review on the business cycle correlation issue; then, we shall use a model which enables us to study the correlation between business cycles throughout the European Union, and in particular between the NMS' business cycles and the "euro area business cycle" (EABC), if the latter exists.

Introduction

Real convergence between two groups of countries is effective when the criteria determined by the Optimal Currency Area (OCA) theory are fulfilled, and when the business cycles are found to be correlated between the two groups of countries. The Optimal Currency Area (OCA) theory states that countries are more suited to belong to a monetary union when they meet certain criteria related to the real convergence of an economy: a high degree of external

openness, mobility of factors of production, and diversification of production structures. In this paper, we shall try to find out whether real convergence has increased between New Member States (NMS) and the Old Member States (OMS), or more specifically with economies from the *euro area*. We shall try to identify a Euro(pean) business cycle, or EABC. Many studies have been made on this issue, using different techniques and with very diverse results, but our aim in this paper is to cover a longer time period ranging from 1996, beginning of the transition period in most of the NMS, to 2008; besides, we test a bigger number of indicators and provide a benchmark, in order to isolate the impact that we find, from a more general evolution of business cycles in the World. Finally, our study really focuses on the comparison between on the one hand euro area countries, and on the other hand NMS, with a specific goal: *to prove, if it is possible, that some NMS, for which there already is a real convergence, are ready to adopt the euro, notwithstanding Maastricht criteria..* We are also going to test the convergence of business cycles between the euro area countries (EAC) and the UK, Denmark and Sweden, in order to determine whether the latter would find an interest in joining the euro area as well. After having reviewed the existing literature devoted to business cycles synchronisation, we shall use a **particular model in order to determine if there is a clear convergence between the NMS' business cycles and the European cycle**, or which would be even better, a "euro area business cycle" (EABC); this would stand in favour of an early adoption of the euro by these countries, perhaps even those which do not fulfil the Maastricht criteria yet. In this model we shall **test the correlation for a certain number of macro economic indicators between NMS and euro area members**.

I) Overview of the literature on business cycle correlation in the European Union

Does the European business cycle or EABC exist, to begin with? **De Haan, Inklaar and Jong-a-Pin (2005)** provide a very useful survey of the empirical research existing on the issue of business cycle synchronization, which reminds us that although periods of bigger and lower synchronization tend to alternate, there is nonetheless some evidence of a greater business cycle synchronization in the euro area during the 1990s. However, they also mention the fact that conclusions obtained by various studies often differ because of differences in periods surveyed, data and benchmarks used; even when using the same methodology, estimation results sometimes differ widely. **De Haan, Inklaar and Jong-a-Pin (2005)** also find that the synchronization process has indeed increased, during the 1990s, due to higher trade intensity; they point out that although many euro countries' business cycles are still different, **there seems to be "a monotone movement towards the emergence of a European business cycle**". For **Bower and Guillemineau (2006)** as well, the implementation of the single European market has increased trade relations across euro area countries, which has contributed to higher business cycle symmetry; this has been reinforced by the introduction of the single currency, which has led to intensified intra-trade industry, or similarity of trade specialisation patterns; these findings support the conclusion of **Frankel and Rose (1998),** according to whom there is an endogeneity of OCA criteria. For **Artis (2003)** on the contrary it is difficult to identify "a homogenous or developing European business cycle" and that "globalisation may be proceeding as fast as Europeanization"; the author uses GDP data for a panel of 23 countries, over a 30 year time-frame, and finds out that the US and Japan are sometimes more closely linked to European core countries, than other European countries (such as Great Britain, Portugal, Ireland or Scandinavian countries). **For Artis then, it means that there is no monotone movement "towards the emergence of a highly coherent and exclusive European cycle**". We can see

that the existence of a real European business cycle is still open to debate; nevertheless, we shall try to determine in this article if there is a correlation between the euro applicants' business cycles and the European cycle, assuming that there is one, or simply with the business cycles of core euro area countries; if it is the case, then it would stand in favour of an early adoption of the euro by NMS.

Maastricht criteria are related to nominal convergence; real convergence needs to be assessed considering other criteria, among which those developed by the **Optimal Currency Area (OCA) theory; this theory was implemented in the 60's by Robert Mundell[1], and enriched both by Ronald Mac Kinnon (1963) and Peter Kenen (1969).** In order for a monetary union to be qualified as optimal, countries that belong to this area should fulfil several criteria, such as the degree of openness of the country, its industrial diversification and the mobility of production factors; indeed, factor markets must be sufficiently flexible to absorb shocks in a context where exchange rate movements are no longer possible. For the time being, the two first criteria do not seem to pose problem: NMS are open economies, and they trade more and more with old European Member States. Moreover, diversification of production structures is increasing very rapidly in NMS. According to **Boone and Maurel (1999),** in some of the CEECs, a strong correlation with the European cycle (notably with Germany) has already been observed, in particular in the Czech Republic, in Slovakia and in Hungary; these countries had chosen a monetary anchorage policy, at least until recent years, which might have contributed to strengthen the degree of symmetry of shocks and to stabilize inflationary anticipations, thus reducing risk premiums and facilitating investments. The model of **Frankel and Rose (1998),** that shed light on an endogenous cycle's hypothesis, favoured by trade

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[1]R. Mundell, 1961; R. Mundell, 1997.

integration, pleads in favour of an early adoption of the euro by NMS; a rise in trade relations

enabled by an early accession to the euro area tends to strengthen the synchronization of cycles,

which "increases the aptitude of countries which, *ex ante,* do not satisfy the criteria of entry in

the monetary union, to satisfy them *ex post*". Nevertheless, Frankel and Rose point out that when

countries have not finished the first phase of the transition yet (relative price restructuring and

economic growth recovery), a strategy of anchorage can reveal itself counter-productive. As

explained by **Babetskii (2004),** the endogeneity argument described by Frankel and Rose (1998)

can illustrate the position taken by the European Commission in 2000, for which "closer

integration leads to less frequent asymmetric shocks and to more synchronised business cycles

between countries", which in turn makes it possible and less costly for a common monetary

policy to operate; on the contrary, according to what **De Grauwe (1997)** has called the

"Krugman view", **Krugman (1993)** believes that closer integration leads to higher specialisation

which in turn brings about more idiosyncratic shocks. Babetskii has tested both views and finds

that "an increase in trade intensity leads to higher symmetry of demand shocks" and that "a

decrease in exchange rate volatility has a positive effect on demand shock convergence", which

tends to support the European Commission's view, or Frankel and Rose's view; concerning

supply shocks, the results appear to be ambiguous or non significant. **Rose (2000)** has

demonstrated later on that currency unions increased trade in participating countries by 300% on

average; **Micco, Stein and Ordonez (2003)** confirm that joining a European currency union

leads to a surge in trade by 4 to 16%; moreover they find that the microeconomic benefits of the

European monetary union are higher than the macroeconomic cost of losing the monetary

instrument. On the other hand, **Berger and Nitsch (2006)** find that the euro has had no real

effect on trade among members; instead they point out the existence a gradual increase in trade

intensity throughout the fifty years of continued European integration, which culminates with the birth of the single currency.

Concerning another OCA criteria, which is flexibility of movement of factors of production, **Moore and Pentecost (2006)** use a structural VAR model in order to examine the flexibility of labour markets in eight EU countries (four old and four new members) by analyzing the responsiveness of real wages to temporary and permanent shocks; they discover that there are longer persistent disequilibria in labour markets in Italy, Poland and Slovakia, which means that they exhibit a low flexibility in this market, as opposed to the Czech Republic and Hungary. They conclude that, from this perspective, some of the NMS may prove better candidates for joining the euro area than present members. **Boeri and Garibaldi (2005)** also argue that NMS do not have more rigid labour markets than western MS, which shows that they are not less suitable for EMU; they conclude that "even though labour markets in NMS have some structural problems, highlighted by large and stagnant pools of unemployment, they do not seem to work any worse than the labour markets in many current EMU countries". Early adoption of the euro in these countries, especially in Baltic States, would rather encourage job creation, by modifying wage setting due to budgetary discipline.

Concerning the question as to whether the euro area at present is an OCA, **Lane (2006)** argues that even though there is increasing evidence that a monetary union has increased trade and financial integration among participants; however, structural rigidities in the labour and goods markets remain, and "it remains an open question whether national economies will prove to be sufficiently flexible to enable smooth adjustment in the event of a major asymmetric shock or a financial crisis"; moreover, the author believes that "EMU acts as an amplification mechanism for asymmetric shocks", in the sense that a common nominal interest rate automatically leads to a divergence in real interest rates in members of the euro area, because of

differences in national inflation rates. For **Van De Coevering (2003),** Hungary, the Czech Republic and Slovakia have converged more quickly towards the euro area in terms of growth of intra-industry trade; concerning output, only Hungary and Slovenia display a significant degree of convergence, but overall from an OCA perspective most countries, even in the euro area, have diverged instead of converging, since the mid-nineties. According to **Weimann (2003)**, who uses methodologies linked to the theory of optimum currency areas with a structural VAR approach in order to identify economic shocks that have hit the countries wishing to join the euro area, in the past, correlations of these shocks with those of current EMU countries shed light on the question of whether a common monetary policy may be suitable or not in CEECs. The author believes that "one cannot judge the CEECs as worse accession candidates than present EMU members", with regard to asymmetric shocks, which means that "they are not systematically less suitable for EMU than its present members". Among the NMS, Hungary appears to be the most strongly correlated concerning both shock types with the euro area, according to Weimann. On the other hand, as **Berger (2004)** explains, "economic trends still differ greatly in the old and new member states", which argues against undue haste in pursuit of euro membership. In NMS, growth rates are much higher, as well as inflation rates, due to an inflow of FDIs and to catching-up effects, than in old MS; that is the reason why, according to the author, a single monetary policy is not likely to fit, for the moment at least, all European countries. Business cycles are far from being synchronized between Western and Eastern countries, even with stronger trade integration; as the author explains, "it is the demand side that represents the greatest obstacle to closer business cycle synchronization with the euro area (…) because of sustained differences in consumer behaviour and fiscal policy". Thus, the fact that countries that adopt the euro lose the possibility of using the exchange rate policy can be annoying for the ones that have divergent economic cycles. On the contrary, according to Berger, countries with high inflation rates would be better

off if they entered the ERM2, since it would enable them to put the accent on price stability. Similarly, **Kontolemis and Ross (2005)** point out that real demand shocks seem to explain a relatively small part of the variance of exchange rates in Estonia and Lithuania; in addition, they find that "Hungary, the Czech Republic and Slovenia seem to be influenced significantly by demand shocks, a finding which suggest that an early move to join ERM2 could, ceteris paribus, be more problematic in the short to medium term". For **Carmignani (2005),** European emerging market economies are poorly synchronized with the euro area except for Hungary and Poland, two countries for which synchronization is significant. Nevertheless, **Kutan and Yigit (2005)** find a strong evidence of a real stochastic convergence in CEECs, meaning that they adjust to euro area output shocks, although nominal convergence to EU standards still appears idiosyncratic; the Baltic states exhibit the strongest convergence (in particular concerning monetary policy and price level convergence, due to their hard peg exchange rate regime), indicating that they can join the euro area. But the other CEECs show little convergence with the euro area (Germany is used as a benchmark in their study) and should rather focus on fiscal discipline instead of wanting to join the ERM2 too soon. **Firdnuc and Korhonen (2001)** study the correlation of supply and demand shocks between CEECs and the euro area countries (not only with Germany as often), through the 90's; they come up with several interesting findings: firstly they confirm that members of the euro area present a high correlation, even Italy which was considered as "peripheral"; then, they find that supply shocks in some CEECs such as Hungary and Estonia are quite highly correlated with euro area shocks, partly because of huge amount of FDI inflows, and the existence of extensive trade relations with western European countries; Slovenia also shows a good although lower correlation index, but in other CEECs, according to this study, the asymmetry of business cycles continues to be important, which means that an early adoption of the euro may be problematic. Finally Hungary also has a high

correlation of demand shocks with the euro area. As to **Frenkel and Nickel (2002),** they show a clear correlation of demand shocks between some CEECs (Poland and Hungary) and the euro area; nevertheless, concerning supply shocks, Poland seems to be the only country demonstrating a negative correlation. In a later study, **Frenkel and Nickel (2005)** find that some of the more advanced CEECs have relatively strong economic links with major euro zone countries, and therefore may be better prepared for the euro, such as the Czech Republic, Estonia and Hungary, even though overall, "the CEECs as a group exhibit still considerably different disturbances and adjustment paths in comparison with the euro zone countries". In addition, **Eickmeier and Breitung (2005)** investigate co-movements between CEECs and the euro area and they find that there is considerable heterogeneity among CEECs, meaning that, for some of them, accession to EMU is likely to be more costly; but they find that Poland, Slovenia, Hungary, Estonia are "more suitable EMU candidates". According to **Traistaru (2005),** bilateral correlations of business cycles between the euro area countries and NMS are low, suggesting that "the new EU countries are not part of an optimal currency area in the traditional sense", although similarity of economic structures and deeper trade integration should allow for a higher business cycle convergence in the long-run. Likewise, **Bower (2005)** finds that the degree of real integration achieved by CEECs is still low, and therefore that they might incur huge short-term costs if they adopt the euro too soon. A study of the convergence of the real economy proxied by GDP and industrial production of CEECs with the euro area indeed shows that only Slovenia seems to exhibit a synchronised common cycle; codependence evidence is found for the Czech Republic, Hungary and Slovakia which means that "they can be considered of an intermediate degree of cyclical movement with the euro area".

      Brada, Kutan and Zhou (2005) observe that whereas earlier members of the EU demonstrated time varying cointegration with core countries (Germany and France) from 1980 to

2000, "cointegration for the transition economies was comparable for M2 (base money) and prices, but not for monetary policy and industrial output"; they conclude their study by saying that "while a close link to the Euro is feasible upon accession to EU membership, they would be well advised to retain some measure of policy autonomy to deal with productivity shocks whose magnitude and timing may continue to differ significantly from the shocks affecting the EU core". **Artis, Marcellino and Proietti (2004)** also analyse the evolution of business cycles in accession countries, and they find that for most of them the adoption of the euro in a near future is not necessarily recommended, in the light of the OCA theory. In particular, the degree of concordance among the accession countries is not as large as within the euro area members, except for the Baltic countries; furthermore between the two groups the synchronization is low concerning GDP data; when looking at data referring to industrial production, Baltic countries continue to form an integrated economic area, comprising also the Czech Republic; moreover, Hungary appears to be highly correlated with the eurozone, and Germany has a very high "cyclical sympathy" with a group made up of Poland, Slovenia, Estonia, Hungary and the Czech Republic, concerning concordance measures. Overall, what is striking in this study when analysing different indicators and measures, is that Poland, Hungary and Slovenia appear to be the countries that are the closest to the euro area, in terms of real convergence. In **Darvas and Szapary (2004)**, Hungary, Poland and Slovenia again appear as being the CEECs that have achieved a high degree of synchronisation with the EMU for GDP, industrial production and exports, but not for consumption and services; besides some evidence is found of a high synchronization of business cycles among euro area members themselves. Another paper by **Darvas, Rose and Szapary (2005)** shows, by using data from 21 OECD countries, that reduced fiscal deficits increase business cycle synchronization; in that sense, the Maastricht criteria might have "indirectly moved Europe closer to an OCA, by reducing countries' abilities to create

idiosyncratic fiscal shocks". Finally, **Firdnuc and Korhonen (2006)** offer a very interesting "Meta-analysis of the business cycle correlation between the euro area and the CEECs", in which they review 35 existing studies related to this topic; their main finding is that, on the whole, CEECs have comparably high correlation with the euro area business cycle, even if "estimation methodologies can have a significant effect on correlation coefficients"; this meta-analysis provided by Firdnuc and Korhonen points out that "the highest average estimates of business cycle correlation with the euro area are reported for Hungary, followed by Slovenia and Poland". Furthermore, Hungary is more highly correlated with the euro area than peripheral countries such as Greece, Ireland or Portugal. Then comes a group of countries that exhibit a lower degree of correlation with the euro area, comprising the Czech Republic, Estonia, and Latvia; Finally, Slovakia has a positive but small correlation index, and Lithuania exhibits negative correlation with the euro area. As indicated by the authors, this study shows that overall, "the available estimates of business cycle correlation provide a fairly consistent ranking of the CEECs".

This review of the literature devoted to OCA theory and business cycle convergence shows that it is difficult to give a clear-cut answer to the question; the results in terms of NMS being or not correlated with euro area members often differ widely across the various studies, and depend both on the methodologies and data that are used. Nevertheless, some countries seem to have converged more than others towards the Euro area cycle, if we judge by the frequency of their favourable citation among the results of the different studies that are analysed in this paper: Hungary, Slovenia, the Czech Republic and Poland are often cited as being "more suitable candidates for EMU"; then come the Baltic States and at last Slovakia. This is particularly interesting in the sense that, among the four that are ahead of the list, we have three countries (Hungary, the Czech Republic and Poland) for which euro adoption will happen probably much later, because nominal convergence has not been

totally achieved yet, but mostly because their currency has not entered the ERM2, for the time being. These bigger countries have chosen more flexible exchange rate arrangements, as compared to Baltic States for example. **It would be interesting to find out why these countries have converged more quickly in real terms, when analysing the criteria of the OCA theory and business cycle convergence in particular, towards the euro area, although, in terms of nominal convergence, they have not proved successful.**

II) Our contribution: methodology and data

We shall now try to determine if there is an increasing convergence between groups of countries, NMS and euro area countries in terms of their business cycles; more specifically, in order to study the evolution of business cycles in those two groups of countries, from 1996 to 2008, we are going to test the correlation between these countries' macroeconomic indicators: **Gross Domestic Product (GDP), private spending, public investment, public investment in the construction sector, employment rate, final administration spending and GDP deflator**.

We are going to proceed in two stages: firstly, we will try to determine whether the euro zone evolves in a unique, or at least a very close, cycle. We shall try to identify the most representative countries of the area. Then we shall study the correlation between this representative countries and the group of the new Member States, in order to identify the countries having the closest cycle to the euro zone. This study must enable us to identify the role of the single currency in the convergence process of the EU countries. Does the euro hold a positive, negative or neutral role in this respect?

In order to analyse the business cycle of the euro area, and those of NMS, we use the following methodology:

In the first stage, we undergo a rapid analysis of the correlation of the economic and monetary variable using the quarterly data on the period 1996-2008, in the 27 member states of

the EU. In a second stage, we go through a graphical analysis of the long-term business cycles in the whole group of EU countries (using the business cycles method of Hodrick and Prescott filter[2]). Thirdly[3], we determine whether a converging cycle exists in the euro area. Then we try to indicate precisely which are the NMS that converge, and those that diverge.

We conclude for each of the chosen variables using the results of the analyses displayed in the appendices.

1. Rate of growth of the quarterly GDP (Appendice I):

A. Firstly, we analyse rapidly the correlation of the rate of growth of quarterly GDP between 1996 and 2008. This analysis reveals that Ireland, Greece, but also Spain and Luxembourg to a lesser extent, diverge from the rest of the euro area countries. The most correlated country is Germany, followed by Scandinavian countries and France. Thus, Germany and France might be considered as the most representative countries in the euro area.

B. Secondly, we examine the graphical analysis of the business cycles of countries of the euro area. Results confirm the previous correlation study and show the reference business cycle of the euro area.

C. Thirdly, we proceed in the same way for the group of 10 new member states and for the euro area members. We obtain the following results:

We identify a group of countries that are getting closer to the euro area. In particular, we have by order of importance: Latvia, Slovenia, Cyprus, the Czech Republic, and Slovakia. Of course, we need to bear in mind that Slovenia and Cyprus are already part of the euro area in 2008: Slovenia since 01/2007 and Cyprus since 01/2008 (together with Malta).

We have a group of countries that are far away from the euro area, but also from the rest of the NMS: Bulgaria, Estonia, Lithuania, Hungary, Romania and Malta.

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2 See Appendice VII.

These ties are even more evident if we shorten the period of analysis of quarterly observations. The period 1999-2008 shows links which are much more significant, than the period 1996-2008.

D. To conclude, we can assert that in terms of growth of quarterly GDP, a major convergence exists, although it is not total, inside the euro area. Among the diverging countries, we have Greece and Spain. When we look at NMS, we clearly see a group of countries that stand close to the euro area. Essentially they are the countries that have recently joined or are on the verge of entering the euro area. The other NMS (6) follow very divergent or inconsistent paths.

2. Rate of growth of private spending (Appendice II):

A. A rapid analysis of correlation of the variable of the quarterly rate of growth of private spending between 1996 and 2008 reveals the absence of convergence inside the 12 founding members of the Euro area. Only Germany shows a significatively positive correlation index.

B. The graphical analysis of the business cycles of the entire euro zone confirms this divergence.

C. The correlation analysis and the graphical analysis of the business cycles of the new member states (12 countries) and of the Euro Zone lead to the same findings:

There is no convergence between the NMS and the euro area.

There is no convergence among NMS.

These observations do not alter if we change the time span of the quarterly data.

D. We conclude that in terms of quarterly growth of private spending, no convergence process can be observed between EU countries.

3. Rate of growth of public investment (Appendice III):

A. The correlation analysis of the quarterly growth rate of public spending between 1996 and 2008 reveals the existence of convergence among the 12 founding members of the Euro area,

as well as for Denmark and Sweden. This trend is even more important if we bring back the number of quarterly observations to the period 2000-2008. Same countries continue to diverge, in particular Greece, Spain, Italy, Ireland and Luxembourg. Germany and France endorse a significant role as usual.

B. The graphical analysis of the business cycles of the entire euro zone confirms the previous correlation analysis and put in perspective the reference business cycle of the euro area by showing the strong resemblance between Germany and France. It also shows the divergence of other countries, in particular Spain and Italy.

C. The correlation analysis and the graphical analysis of the business cycles of the 12 NMS and of the Euro Zone lead to the following findings:

- We witness the emergence of a group of countries that are getting closer to the euro area: Poland followed by Romania, Slovenia and to a lesser extent Slovakia.

- France demonstrates a strong convergence with this group of countries.

- NMS form a heterogeneous group, distinct from the euro area but also from the rest of NMS; these countries are the following: Bulgaria, Cyprus, Estonia, Lithuania, Latvia, Hungary, Malta and the Czech Republic.

D. We conclude that in terms of quarterly growth of public spending, a convergence process can be observed between EU countries, even if is only partial. When looking at the NMS, we can clearly distinguish a group of countries that are converging towards the euro area, but which do not necessarily correspond to the ones that are close to *entering* the euro area. The other NMS follow divergent or inconsistent paths.

4. Rate of growth of public investment in construction (Appendice IV):

A. The correlation analysis of the quarterly growth rate of public spending in the construction sector between 1996 and 2008 reveals the existence of significant convergence

among the 12 founding members of the Euro area, as well as for Sweden and Denmark. The only countries that continue to diverge are Greece and Ireland. Germany and France endorse a significant role as usual.

B. The graphical analysis of the business cycles of the entire euro zone confirms the previous correlation analysis and puts in perspective the reference business cycle of the euro area by showing the strong resemblance with Germany and France. The only countries that diverge suffer from a lack of observations.

C. The correlation analysis and the graphical analysis of the business cycles of the 12 NMS and of the Euro Zone lead to the following findings:

- We witness the emergence of a group of countries that are getting closer to the euro area: Cyprus followed by Slovenia and to a lesser extent Poland. The euro could thus play a significant role.

- The rest of the NMS form a heterogeneous group, distinct from the euro area but also from the rest of NMS. Turkey is part of this group.

D. We conclude that in terms of quarterly growth of public spending in the construction sector, a convergence process seems to exist, although partially, between EU countries. Many of the NMS diverge, except for three countries, among which two have already adopted the euro. Thus, it seems like the euro plays a positive role in this sector. Finally, the shortening of the time period to 2000-2008 does not show different results.

5. Rate of growth of employment (Appendice V):

A. The correlation analysis of the quarterly growth rate of employment between 1996 and 2008 shows a minor convergence among the 12 founding members of the Euro area. Some countries suffer from a lack of data in the Eurostat database. Germany and France play a significant role as usual. Other countries show a correlation rate which is lower than 60%.

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B. The graphical analysis of the business cycles of the entire euro zone confirms the previous correlation analysis and shows a very small convergence inside the euro area.

C. The correlation analysis and the graphical analysis of the business cycles of the new member states (12 countries) and of the Euro Zone lead to the following findings:

- Few countries have available data.

- There is no significant convergence with the euro area..

D. We conclude that, in terms of quarterly growth of employment, a very slight convergence process seems to exist inside the euro area, but no convergence process seems to exist between the euro area and NMS.

6. Rate of growth of final administration spending (Appendice VI):

A. The correlation analysis of the variable of the quarterly growth rate of final administration spending between 1996 and 2008 shows a total absence of convergence among the 12 founding members of the Euro area.

B. The graphical analysis of the business cycles of the entire euro zone confirms the total divergence.

C. The correlation analysis and the graphical analysis of the business cycles of the12 new member states and of the Euro area lead to the following findings:

- There is no convergence between NMS and the euro area.

- There is no convergence among NMS.

D. We conclude that in terms of quarterly growth of final public spending, there is no convergence process between EU countries, as there is no convergence process between the euro area and the NMS.

7. **GDP deflator (Appendice VII):**

A. The correlation analysis of the variable of the quarterly growth rate of the GDP deflator between 1996 and 2008 shows a total absence of convergence among the 12 founding members of the Euro area, and also with Denmark.

B. The graphical analysis of the business cycles of the entire euro zone confirms this total convergence.

C. The correlation analysis and the graphical analysis of the business cycles of the new member states (12 countries) and of the Euro Zone lead to the following findings:

- There is a strong convergence between NMS and the euro area.

D. We conclude that in terms of quarterly growth of the GDP deflator, there is a strong convergence between all EU countries. The existence of the Maastricht criteria plays an important role in this respect.

V) Conclusion: Is the correlation between the NMS' business cycles and the European business cycle increasing?

The New Member States have accomplished considerable efforts in order to enter the EU. The next step for them is to join the euro area. Some of the NMS have already adopted the euro: Slovenia in January 2007, followed by Cyprus and Malta in January 2008, and by Slovakia on January 1st, 2009. As to the other countries that have recently entered the EU, they seem to fall into two categories: those which seem to closely follow the business cycle observed in the euro area, and those which are still on a diverging path. Overall the results that we obtain through our empirical survey are consistent with the results described in our literature survey. In particular, we observe that concerning the members of the euro area, Germany and France are the countries that are the most representative of the area; then, when we observe the rate of growth of GDP in

the NMS, we find that a group of countries stand very close to the euro area trend: **Latvia, Cyprus, the Czech Republic and Slovakia**. In terms of the growth rate of private spending, on the contrary, we cannot find a common trend, in the euro area or among NMS; in terms of the growth rate of public investment, it seems like **Poland** is close to the euro area, followed by **Romania and Slovakia.** Finally, in terms of GDP deflator, there appears to be a total convergence between the NMS and the euro area, which seems logical since NMS are trying to get closer to the Maastricht criteria.

Overall we can conclude that in some countries, the adoption of the euro can be envisaged rather quickly, notwithstanding the fulfilment of the Maastricht criteria which we have not taken into account in this study, our aim being to search for the existence of a real convergence in the countries' business cycles. In terms of fulfilling the OCA criteria, the literature review has shown that a few NMS stood out: **Hungary, the Czech Republic and Poland**, followed by the **Baltic States, and Slovenia and Slovakia** which have already entered the euro area. Thus, it seems like our study is rather consistent with the findings exposed in the first part of the paper, except for Hungary which does not exhibit a huge correlation with the euro area. Maybe the explanation lies in the fact that we have collected our data on a rather long period of time and, most of all, that we take into account the very recent data; we know that in recent periods, Hungary has shown a clear divergence from other NMS, in terms of the evolution of its public deficit and inflation rate in particular. But **Poland, the Czech Republic and Latvia** may find it judicious to adopt the euro pretty soon, since their economies exhibit a real convergence with the euro zone economies, but then of course they need to fulfil the Maastricht criteria.

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Appendice I : Rate of growth of quarterly GDP.

- **Correlation analysis within the euro area (12) :**

	EA12
EA12	1,00
BELGIUM	**0,76**
GERMANY	**0,90**
IRLAND	0,27
GREECE	-0,08
SPAIN	0,57
FRANCE	**0,83**
ITALY	**0,80**
LUXEMBOURG	0,55
NLAND	**0,85**
AUSTRIA	**0,68**
FINLAND	**0,84**
UK	0,42

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **within the initial euro area (12) :**
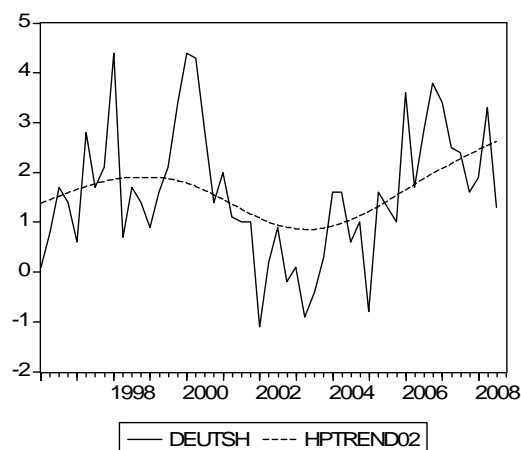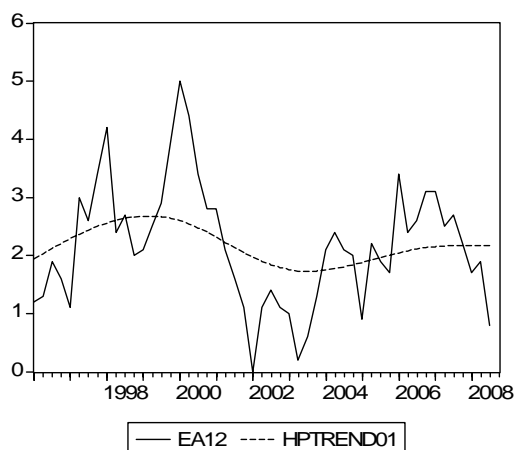
Correlation analysis between the initial Euro area (12) and the NMS, 1999-2008 :

|	EA12	CZECH	CYPRUS	LATVIA	MALTA	POLAND	SLOVENIA	SLOVAKIA
EA12	1,00	**0,63**	**0,67**	**0,80**	0,43	**0,58**	**0,73**	0,45
BULGARIA	0,26	0,47	0,16	0,26	0,39	0,44	0,46	0,32
CZECH	**0,63**	1,00	**0,59**	**0,78**	0,57	**0,75**	**0,70**	**0,66**
ESTONIA	0,44	0,24	0,11	0,62	0,27	0,12	0,26	0,03
CYPRUS	**0,67**	**0,59**	1,00	**0,57**	0,28	0,46	**0,54**	0,38
LATVIA	**0,80**	**0,78**	**0,57**	1,00	**0,53**	**0,53**	**0,71**	0,51
LITHUANIA	-0,01	0,21	-0,26	0,12	0,09	0,34	0,00	0,33
HUNGARY	-0,15	-0,36	-0,28	-0,12	-0,23	-0,34	-0,39	-0,62
MALTA	0,43	**0,57**	0,28	**0,53**	1,00	0,48	**0,52**	**0,54**
POLAND	**0,58**	**0,75**	0,46	**0,53**	0,48	1,00	**0,60**	**0,66**
ROMANIA	0,39	0,26	0,39	0,21	-0,14	0,37	0,42	0,11
SLOVENIA	**0,73**	**0,70**	**0,54**	**0,71**	**0,52**	**0,60**	1,00	**0,66**
SLOVAKIA	0,45	**0,66**	0,38	**0,51**	**0,54**	**0,66**	**0,66**	1,00
UK	0,42	0,21	0,06	0,26	0,11	0,44	0,25	0,26
CROATIA	0,10	-0,09	-0,25	0,21	0,13	0,04	0,24	0,12
TURKEY	0,16	0,42	-0,02	0,30	0,61	**0,51**	0,29	0,18

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**
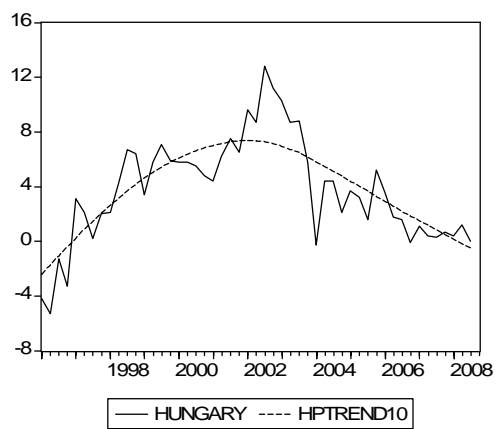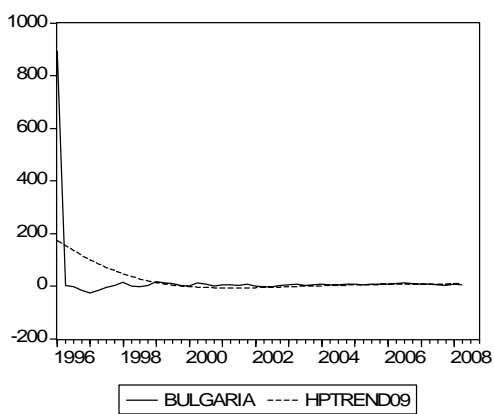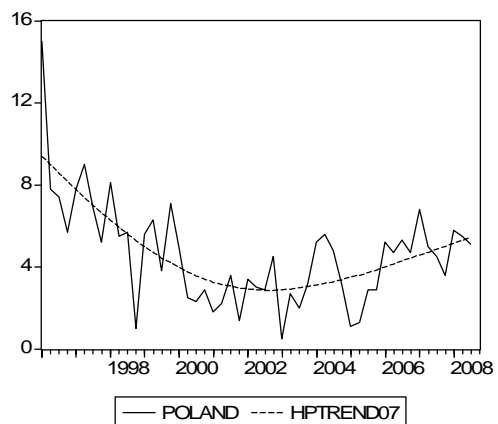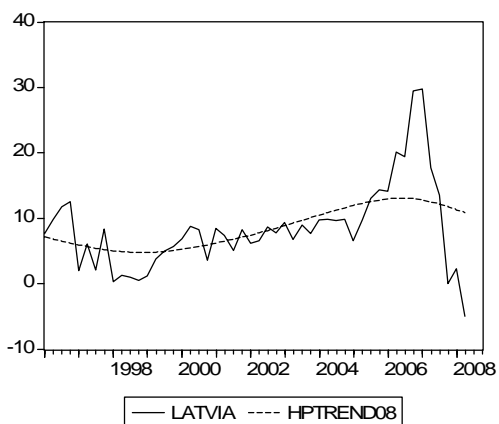
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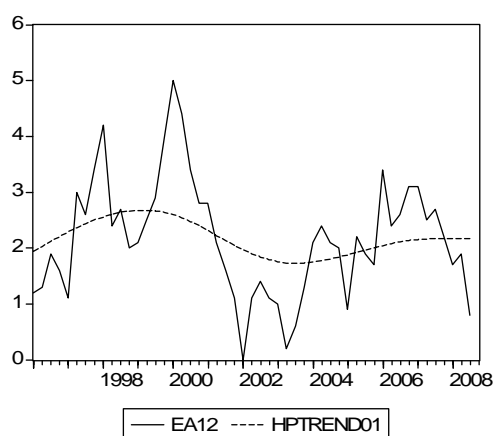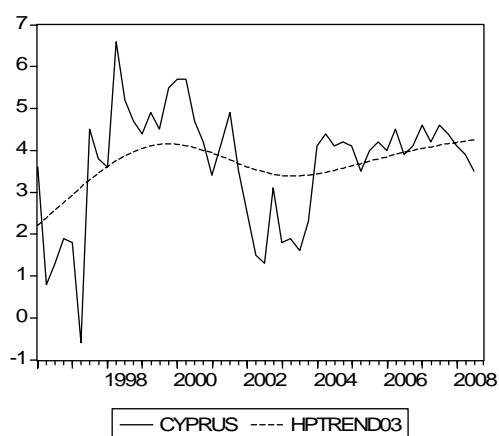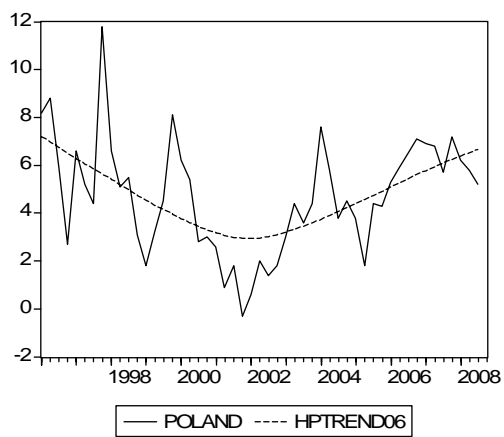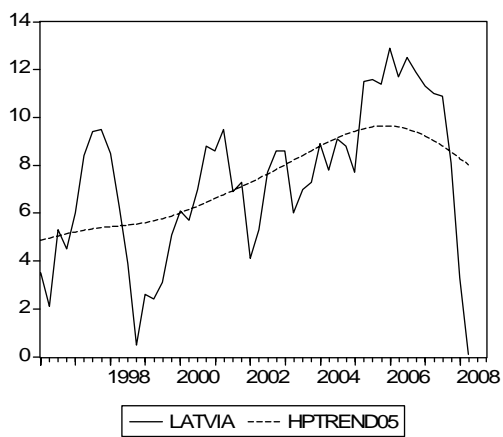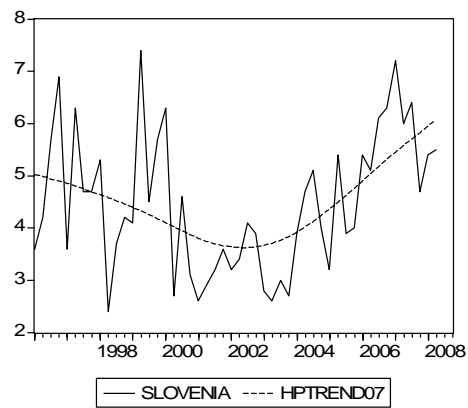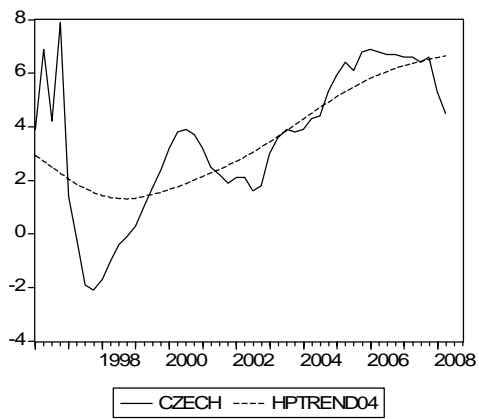
2. __1999-2008.__
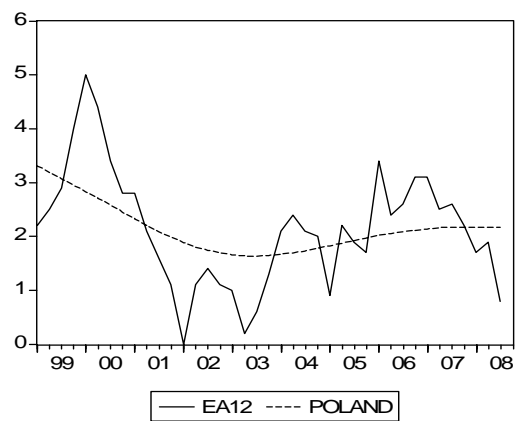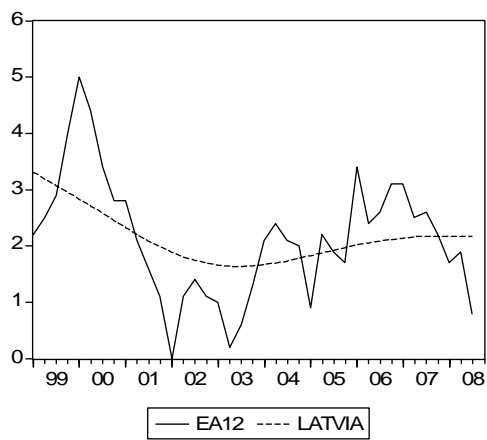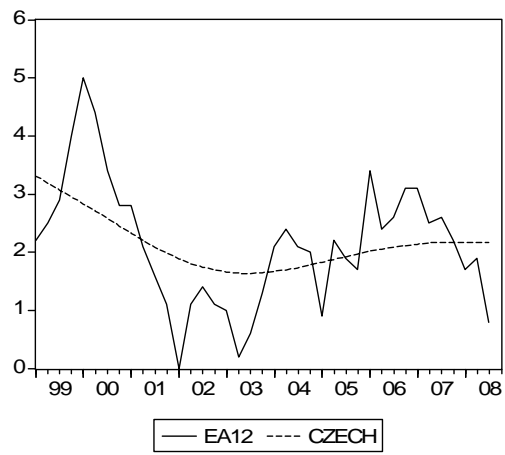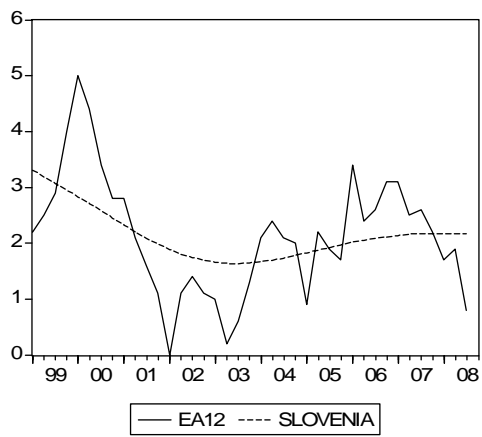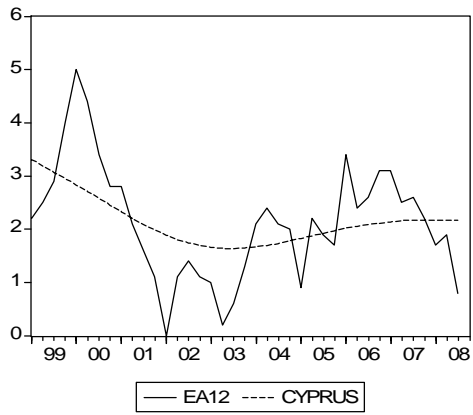
- **Correlation analysis between initial euro area (12) and non convergent NMS, 1996-2008:**

	EA12	**BULGARIA**	**ESTONIA**	**LITHUANIA**	**HUNGARY**	**ROMANIA**
EA12	1,00	0,26	0,44	-0,01	-0,15	0,39
BULGARIA	0,26	1,00	0,19	0,09	-0,10	0,43
CZECH	**0,63**	0,47	0,24	0,21	-0,36	0,26
ESTONIA	0,44	0,19	1,00	0,03	0,42	0,07
CYPRUS	**0,67**	0,16	0,11	-0,26	-0,28	0,39
LATVIA	**0,80**	0,26	**0,62**	0,12	-0,12	0,21
LITHUANIA	-0,01	0,09	0,03	1,00	-0,23	-0,18
HUNGARY	-0,15	-0,10	0,42	-0,23	1,00	0,06
MALTA	0,43	0,39	0,27	0,09	-0,23	-0,14
POLAND	**0,58**	0,44	0,12	0,34	-0,34	0,37
ROMANIA	0,39	0,43	0,07	-0,18	0,06	1,00
SLOVENIA	**0,73**	0,46	0,26	0,00	-0,39	0,42
SLOVAKIA	0,45	0,32	0,03	0,33	-0,62	0,11
UK	0,42	0,05	0,33	0,46	0,02	0,09
CROATIA	0,10	-0,19	0,22	0,16	-0,04	-0,30
TURKEY	0,16	**0,60**	0,34	0,19	0,14	0,15

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and non convergent NMS, 1998-2008**


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Appendice II: Rate of growth of private spending

- **Correlation analysis within initial euro area (12) :**

	EA12
EA12	1,00
BELGIUM	0,47
GERMANY	**0,77**
IRELAND	**0,59**
GREECE	0,35
SPAIN	0,49
FRANCE	**0,52**
ITALY	**0,73**
LUXEMBOURG	0,06
NETHERLANDS	-0,03
AUSTRIA	**0,51**
FINLAND	0,26
UK	-0,48

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**
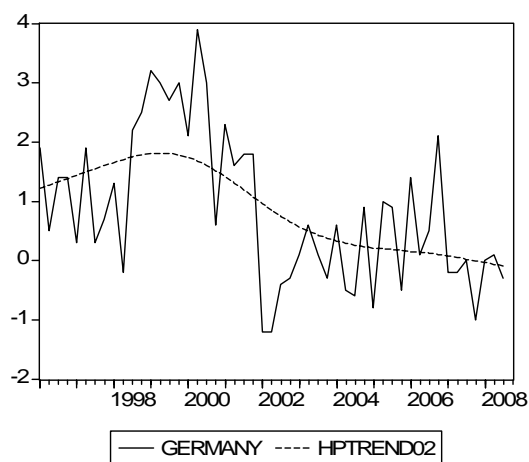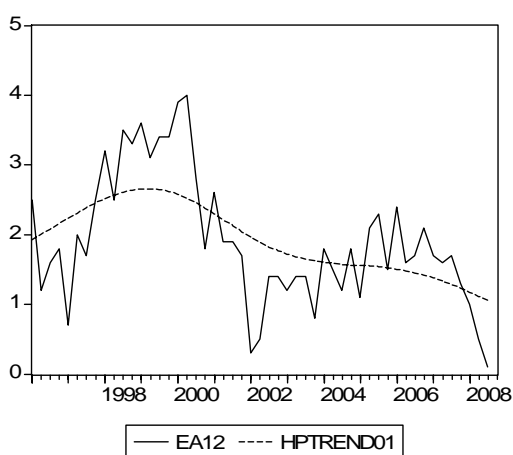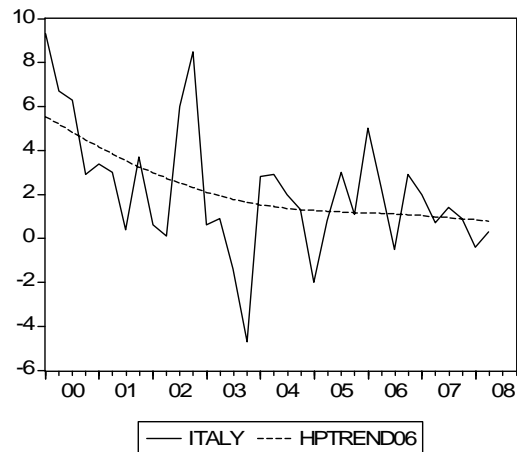
- **Correlation analysis between Eura area and NMS, 1996-2008 :**

	EA12	BUL	CZ	ESTO	CYP	LATV	LITH	HUN	MAL	POL	ROM	SLENIA	SLAKIA
EA12	1,00	0,45	0,09	0,29	0,10	0,46	0,03	-0,31	-0,27	-0,05	0,12	0,01	0,34
BULGARIA	0,45	1,00	0,44	0,09	0,18	**0,51**	0,33	**-0,62**	0,21	0,26	**0,51**	0,34	0,06
CZECH	0,09	0,44	1,00	0,25	0,13	**0,55**	0,38	-0,26	0,23	0,28	0,21	0,35	-0,19
ESTONIA	0,29	0,09	0,25	1,00	-0,35	**0,63**	0,22	0,21	-0,24	-0,03	-0,17	0,01	-0,17
CYPRUS	0,10	0,18	0,13	-0,35	1,00	-0,02	0,36	**-0,71**	0,27	0,38	**0,68**	0,19	0,41
LATVIA	0,46	**0,51**	0,55	0,63	-0,02	1,00	0,41	-0,31	-0,05	0,32	0,21	0,07	0,15
LITHUANIA	0,03	0,33	0,38	0,22	0,36	0,41	1,00	-0,46	0,47	0,41	0,51	0,14	-0,04
HUNGARY	-0,31	**-0,62**	-0,26	0,21	-0,71	-0,31	-0,46	1,00	-0,32	**-0,51**	**-0,76**	-0,20	-0,37
MALTA	-0,27	0,21	0,23	-0,24	0,27	-0,05	0,47	-0,32	1,00	0,09	0,46	0,05	-0,38
POLAND	-0,05	0,26	0,28	-0,03	0,38	0,32	0,41	**-0,51**	0,09	1,00	**0,50**	0,17	0,11
ROMANIA	0,12	**0,51**	0,21	-0,17	**0,68**	0,21	**0,51**	**-0,76**	0,46	0,50	1,00	0,26	0,16
SLOVENIA	0,01	0,34	0,35	0,01	0,19	0,07	0,14	-0,20	0,05	0,17	0,26	1,00	-0,28
SLOVAKIA	0,34	0,06	-0,19	-0,17	0,41	0,15	-0,04	-0,37	-0,38	0,11	0,16	-0,28	1,00

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**
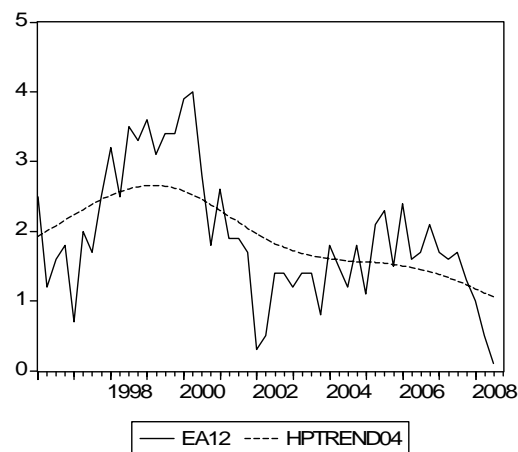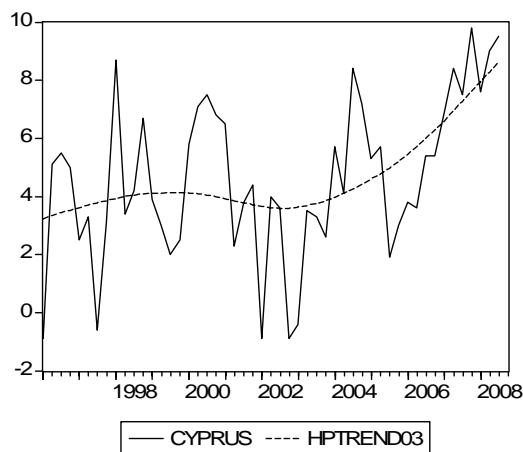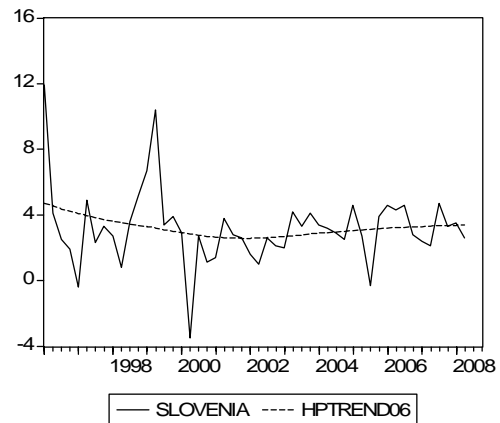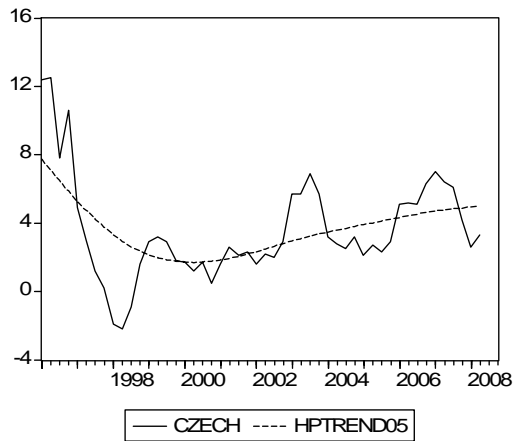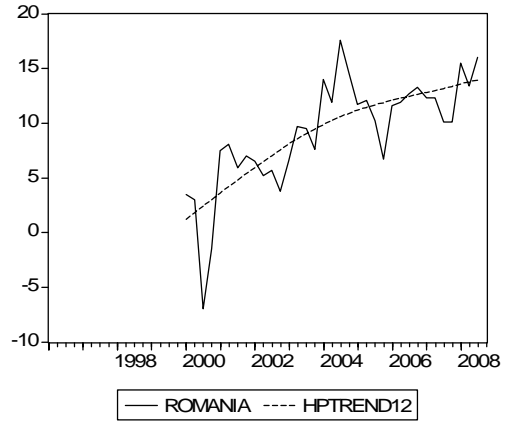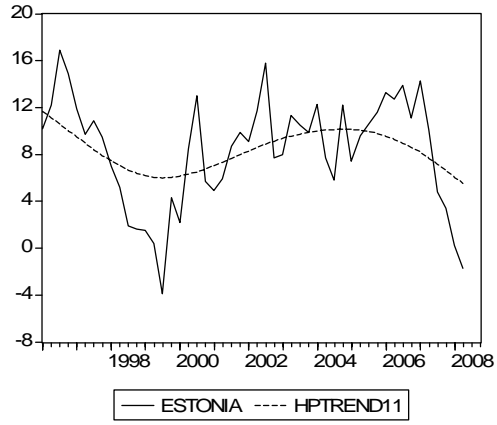
## Appendice III : Rate of growth of public investment.

- **Correlation analysis within initial euro area (12), 1996-2008 :**

	EA12	BELGIUM	GERMANY	IRELAND	GREECE	SPAIN	FRANCE
EA12	1,00	**0,68**	**0,95**	0,15	-0,20	0,43	**0,84**
BELGIUM	**0,68**	1,00	**0,60**	-0,01	-0,59	0,23	**0,61**
GERMANY	**0,95**	**0,60**	1,00	-0,01	-0,16	0,26	**0,70**
IRELAND	0,15	-0,01	-0,01	1,00	0,31	0,45	0,32
GREECE	-0,20	-0,59	-0,16	0,31	1,00	0,26	-0,22
SPAIN	0,43	0,23	0,26	0,45	0,26	1,00	0,46
France	**0,84**	0,61	**0,70**	0,32	-0,22	0,46	1,00
ITALY	0,02	-0,05	-0,10	0,07	0,04	-0,04	-0,19
Luxembourg	-0,04	-0,21	-0,12	-0,08	0,17	0,06	0,03
NETHERLANDS	**0,79**	0,50	**0,83**	-0,11	-0,28	0,19	**0,64**
AUSTRIA	**0,68**	0,47	**0,71**	0,16	-0,19	0,21	**0,68**
FINLAND	**0,53**	0,32	0,43	0,10	-0,12	0,24	**0,67**

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS, 1996-2008 :**
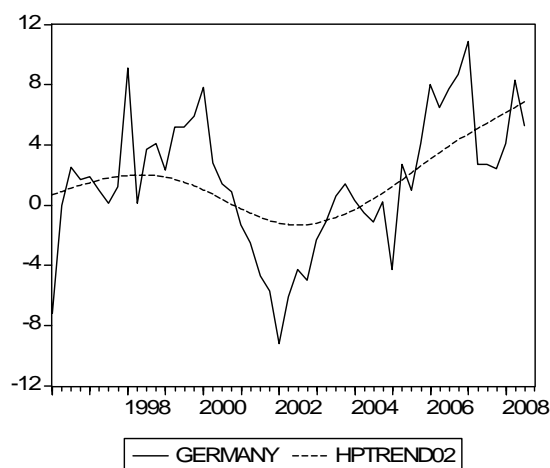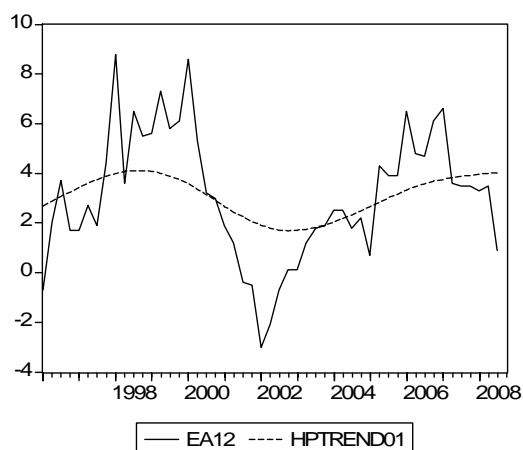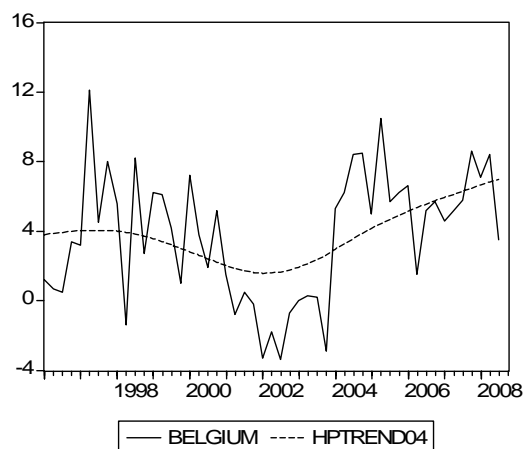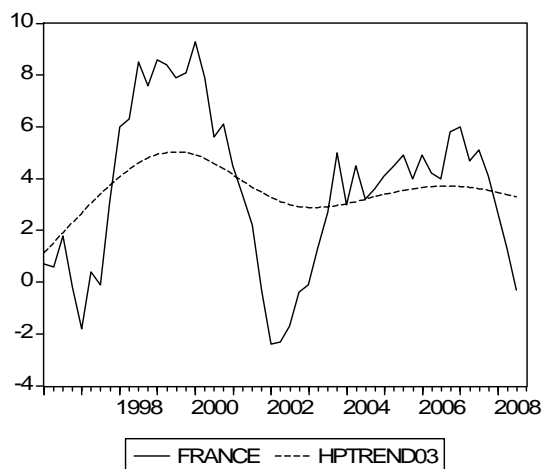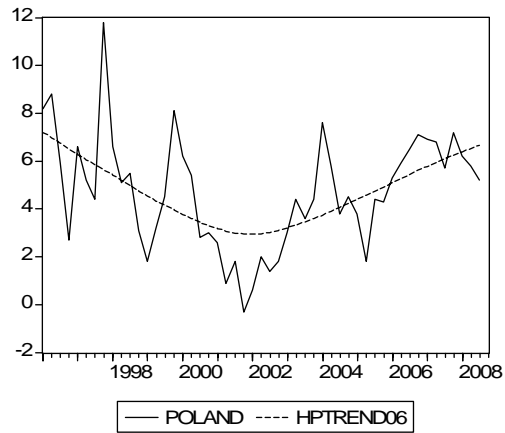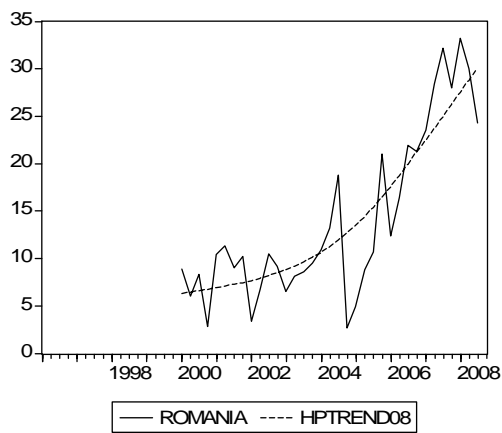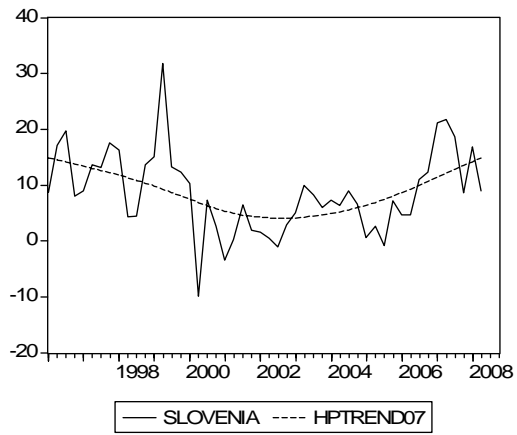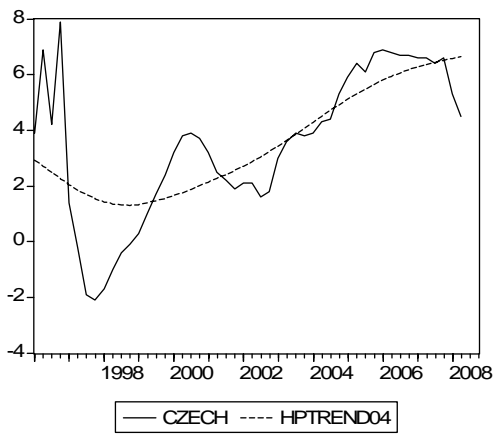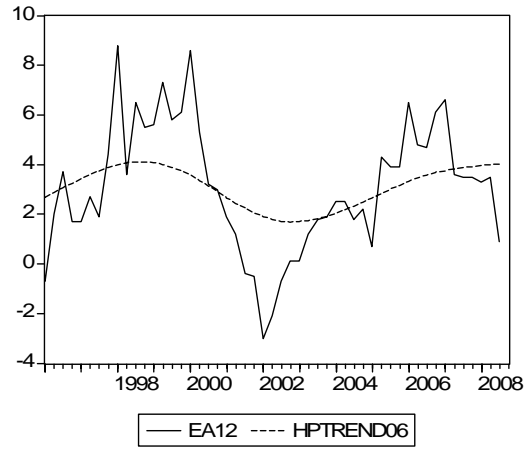
- **Correlation analysis within initial euro area (12), 2000-2008 :**

	EA12	**BELGIUM**	**GERMANY**	**FRANCE**	**NLANDS**	**AUSTRIA**	**SWEDEN**	**DENMARK**
EA12	1,00	**0,68**	**0,95**	**0,84**	**0,79**	**0,68**	**0,73**	**0,50**
BELGIUM	**0,68**	1,00	**0,60**	**0,61**	**0,50**	0,47	**0,73**	0,28
GERMANY	**0,95**	**0,60**	1,00	**0,70**	**0,83**	0,71	**0,66**	0,49
IRELAND	0,15	-0,01	-0,01	0,32	-0,11	0,16	0,16	0,26
GREECE	-0,20	-0,59	-0,16	-0,22	-0,28	-0,19	-0,29	0,08
SPAIN	0,43	0,23	0,26	0,46	0,19	0,21	0,35	**0,53**
FRANCE	**0,84**	**0,61**	**0,70**	1,00	0,64	**0,68**	**0,66**	0,36
ITALY	0,02	-0,05	-0,10	-0,19	-0,21	-0,46	-0,13	-0,06
LUXEMBOURG	-0,04	-0,21	-0,12	0,03	-0,25	-0,21	-0,33	-0,33
NLANDS	**0,79**	**0,50**	0,83	**0,64**	1,00	0,58	**0,59**	0,44
AUSTRIA	**0,68**	0,47	**0,71**	**0,68**	**0,58**	1,00	**0,61**	0,27
FINLAND	**0,53**	0,32	0,43	**0,67**	0,28	0,38	0,29	0,00
SWEDEN	**0,73**	**0,73**	**0,66**	**0,66**	**0,59**	**0,61**	1,00	**0,52**
DENMARK	**0,50**	0,28	0,49	0,36	0,44	0,27	**0,52**	1,00

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS, 2000-2008 :**
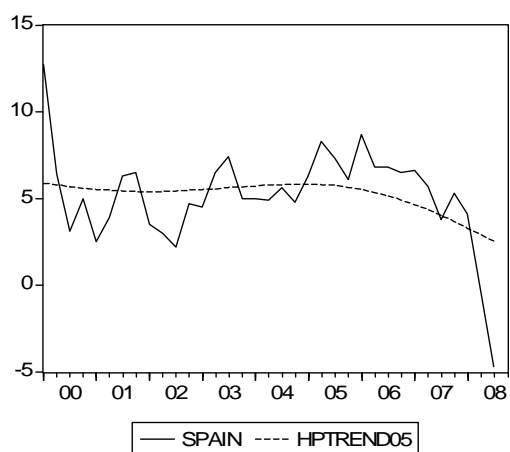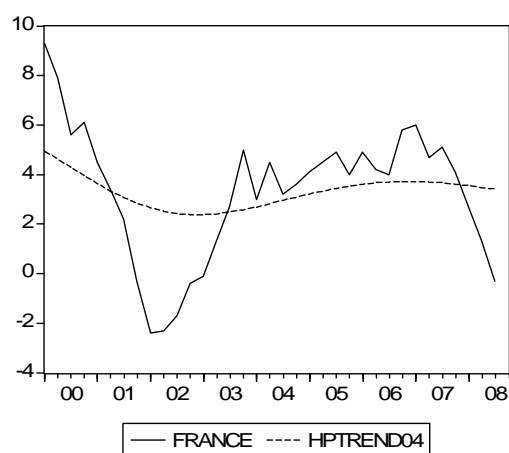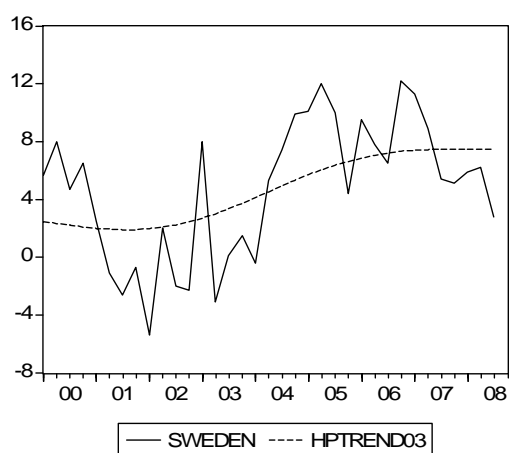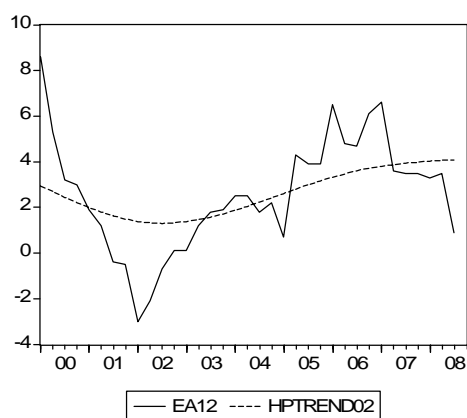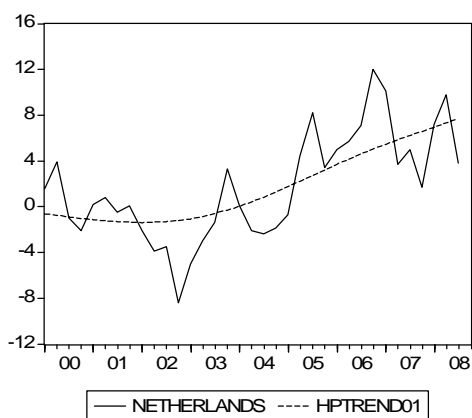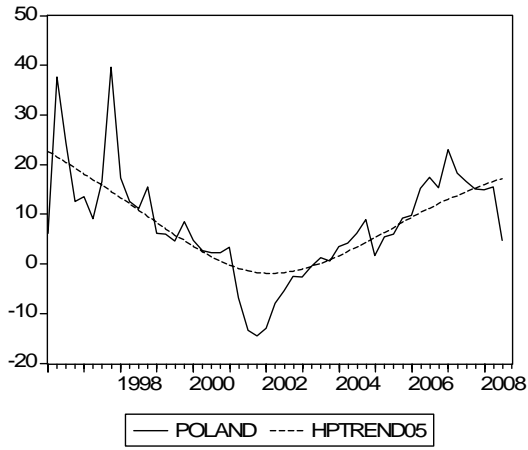
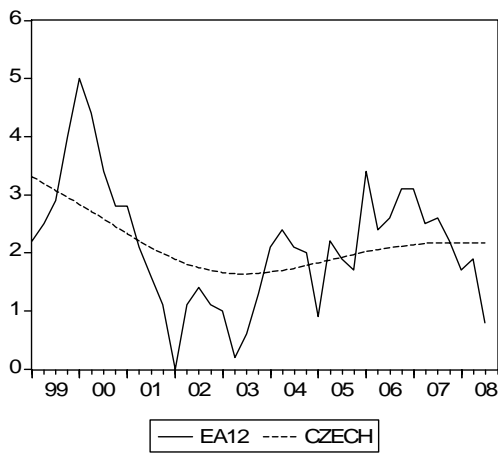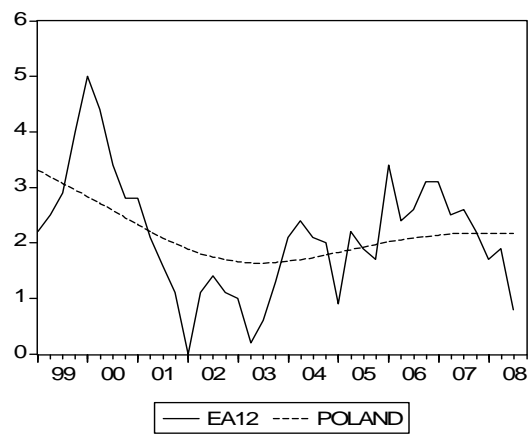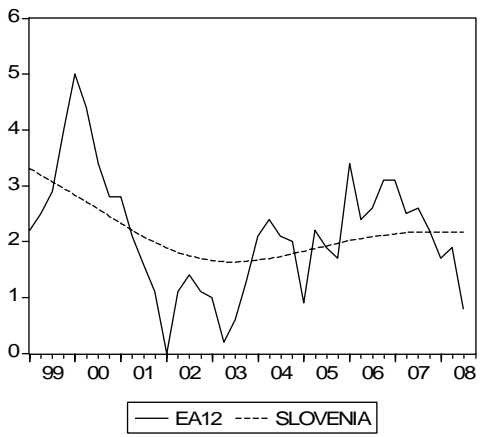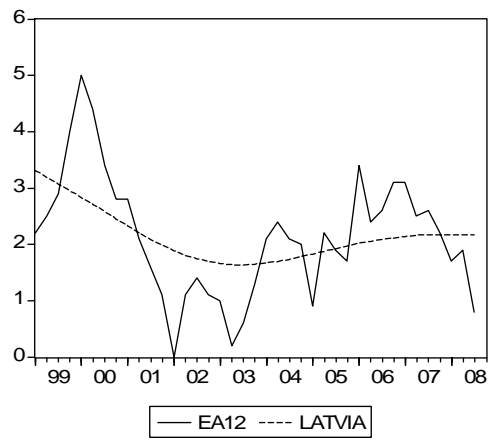- **Correlation analysis between initial Euro area (12) and NMS, 1996-2008 :**

	EA12	GERMANY	FRANCE	POLAND	ROMANIA	SLOVENIA	SLOVAKIA	BULGARIA
EA12	1,00	**0,97**	**0,86**	0,88	0,61	0,51	0,43	0,37
BELGIUM	**0,68**	**0,56**	**0,68**	0,66	0,39	0,36	0,45	0,30
BULGARIA	0,37	0,31	0,38	0,25	0,40	0,37	0,38	1,00
CZECH	0,04	0,08	-0,13	-0,01	0,29	0,05	0,15	0,12
DENMARK	0,55	**0,60**	0,36	0,46	0,30	0,20	0,11	-0,05
GERMANY	**0,97**	1,00	**0,78**	0,89	0,64	0,58	0,29	0,31
ESTONIA	-0,13	-0,04	-0,39	-0,14	-0,08	-0,09	-0,27	-0,33
IRELAND	0,34	0,27	0,38	0,25	-0,03	-0,08	0,09	0,08
GREECE	-0,13	0,05	-0,35	-0,07	0,06	0,25	-0,58	-0,06
SPAIN	**0,61**	**0,55**	0,49	0,35	0,13	0,25	0,23	0,34
FRANCE	**0,86**	**0,78**	1,00	0,76	0,53	0,45	0,53	0,38
ITALY	0,05	-0,05	-0,20	-0,05	0,05	-0,20	0,18	0,05
CYPRUS	0,22	0,22	0,13	0,30	0,32	0,30	0,04	-0,20
LATVIA	0,19	0,13	0,17	0,16	-0,13	-0,14	0,02	0,01
LITHUANIA	0,38	0,43	0,21	0,40	0,53	0,56	-0,20	0,44
LUXEMBOURG	0,00	-0,03	0,00	0,06	0,24	0,22	0,26	0,18
HUNGARY	-0,41	**-0,54**	-0,29	-0,47	-0,42	-0,45	-0,04	-0,04
MALTA	0,31	0,27	0,26	0,21	-0,02	0,21	-0,02	0,07
NETHERLANDS	**0,82**	**0,82**	**0,74**	0,69	0,60	0,43	0,46	0,50
AUSTRIA	**0,68**	**0,70**	**0,73**	0,67	0,39	0,49	0,09	0,21
POLAND	**0,88**	**0,89**	**0,76**	1,00	0,73	0,68	0,26	0,25
ROMANIA	**0,61**	**0,64**	**0,53**	0,73	1,00	0,77	0,28	0,40
SLOVENIA	**0,51**	**0,58**	0,45	0,68	0,77	1,00	-0,08	0,37
SLOVAKIA	0,43	0,29	**0,53**	0,26	0,28	-0,08	1,00	0,38
FINLAND	**0,57**	**0,53**	**0,70**	0,50	0,43	0,30	0,38	0,16
SWEDEN	**0,73**	**0,68**	**0,67**	0,74	0,37	0,33	0,35	0,22
UK	0,48	0,49	0,33	0,58	0,64	0,53	0,26	0,23
TURKEY	0,27	0,25	0,14	0,38	0,05	0,07	-0,27	-0,32
ICELAND	0,49	0,37	0,52	0,34	-0,06	-0,12	0,33	0,00

	EA12	**GERMANY**	**FRANCE**	**POLAND**	**ROMANIA**	**SLOVENIA**	SLOVAKIA
EA12	1,00	**0,95**	**0,84**	**0,87**	**0,58**	**0,52**	0,43
BULGARIA	0,37	0,35	0,32	0,26	0,36	0,34	0,39
CZECH	0,06	0,08	-0,10	0,04	0,30	0,06	0,14
ESTONIA	-0,19	-0,15	-0,33	-0,27	-0,31	-0,17	-0,27
CYPRUS	0,21	0,21	0,12	0,28	0,26	0,30	0,04
LATVIA	0,06	-0,09	0,18	-0,08	-0,42	-0,22	-0,03
LITHUANIA	0,26	0,21	0,22	0,19	0,11	0,35	-0,21
HUNGARY	-0,42	-0,57	-0,25	**-0,51**	-0,49	-0,50	-0,06
MALTA	0,30	0,23	0,28	0,21	0,00	0,18	-0,03
POLAND	**0,87**	**0,89**	**0,70**	1,00	**0,75**	**0,69**	0,27
ROMANIA	**0,58**	**0,65**	0,40	**0,75**	1,00	**0,74**	0,25
SLOVENIA	**0,52**	**0,59**	0,41	**0,69**	**0,74**	1,00	-0,06
SLOVAKIA	0,43	0,30	**0,50**	0,27	0,25	-0,06	1,00
GERMANY	0,95	1,00	**0,70**	**0,89**	**0,65**	**0,59**	0,30
FRANCE	0,84	**0,70**	1,00	0,70	0,40	0,41	**0,50**

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**
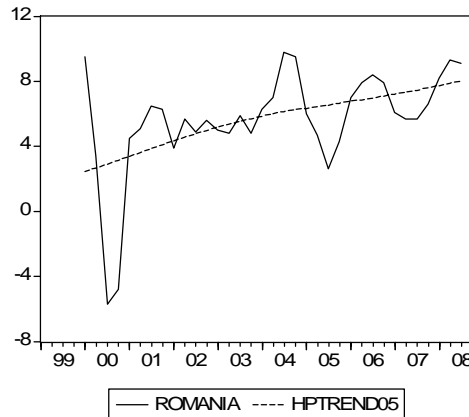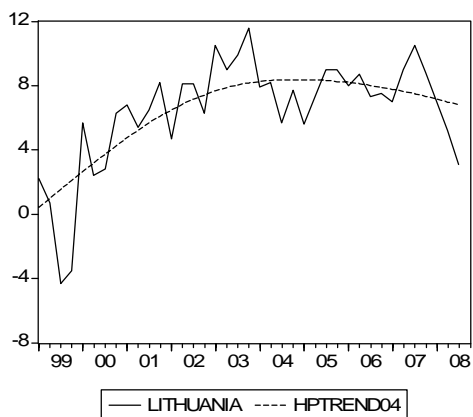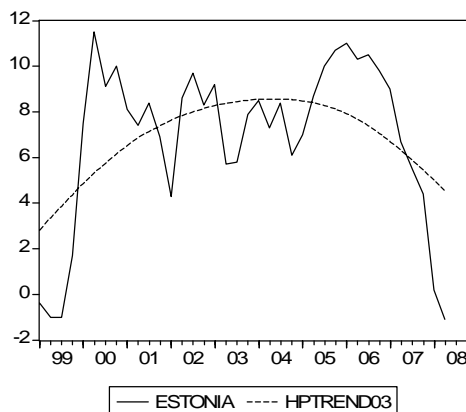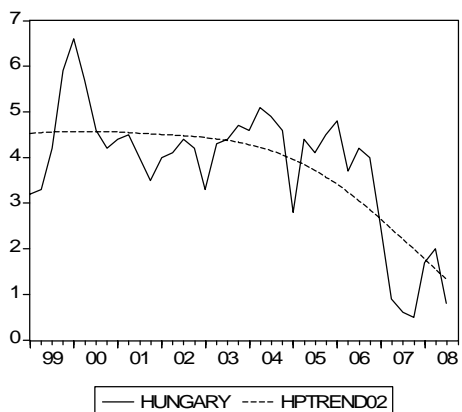

POLAND ---- HPTREND05

EA12 ---- HPTREND06

CZECH ---- HPTREND04

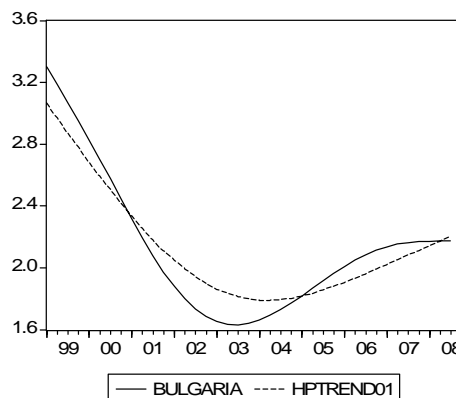SLOVENIA ---- HPTREND07
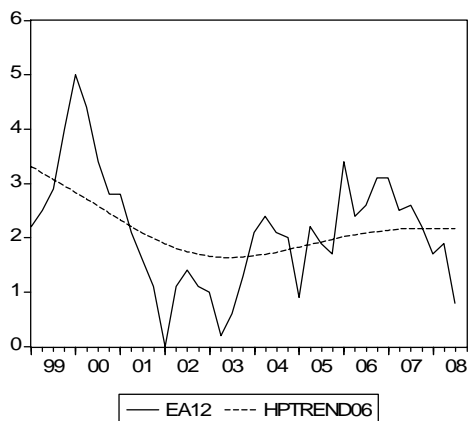

ROMANIA ---- HPTREND08


POLAND ---- HPTREND06

36

o **1999-2008.**
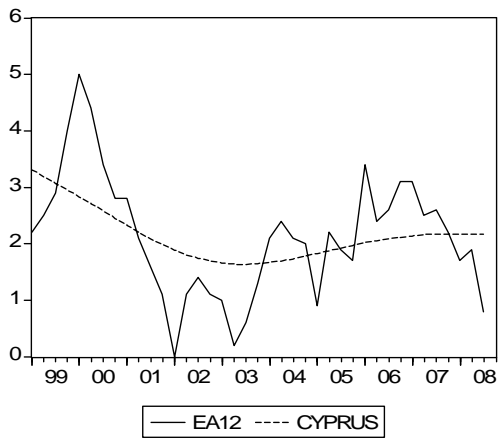
- **Correlation Analysis between initial Euro Zone (12) and NMS non convergent 1996-2008 :**

	EA12	**BULGARIA**	**ESTONIA**	**LITHUANIA**	**HUNGARY**	**ROMANIA**
A12	1,00	0,26	0,44	-0,01	-0,15	0,39
BULGARIA	0,26	1,00	0,19	0,09	-0,10	0,43
CZECH	**0,63**	0,47	0,24	0,21	-0,36	0,26
ESTONIA	0,44	0,19	1,00	0,03	0,42	0,07
CYPRUS	**0,67**	0,16	0,11	-0,26	-0,28	0,39
LATVIA	**0,80**	0,26	**0,62**	0,12	-0,12	0,21
LITHUANIA	-0,01	0,09	0,03	1,00	-0,23	-0,18
HUNGARY	-0,15	-0,10	0,42	-0,23	1,00	0,06
MALTA	0,43	0,39	0,27	0,09	-0,23	-0,14
POLAND	**0,58**	0,44	0,12	0,34	-0,34	0,37
ROMANIA	0,39	0,43	0,07	-0,18	0,06	1,00
SLOVENIA	**0,73**	0,46	0,26	0,00	-0,39	0,42
SLOVAKIA	0,45	0,32	0,03	0,33	-0,62	0,11
UK	0,42	0,05	0,33	0,46	0,02	0,09
CROATIA	0,10	-0,19	0,22	0,16	-0,04	-0,30
TURKEY	0,16	**0,60**	0,34	0,19	0,14	0,15

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and non convergent NMS (1998-2008):**


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Appendice IV : rate of growth of public investment in construction sector

- **Correlation analysis within initial euro area (12) :**

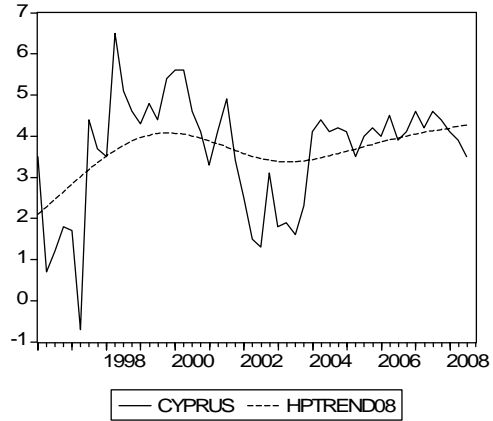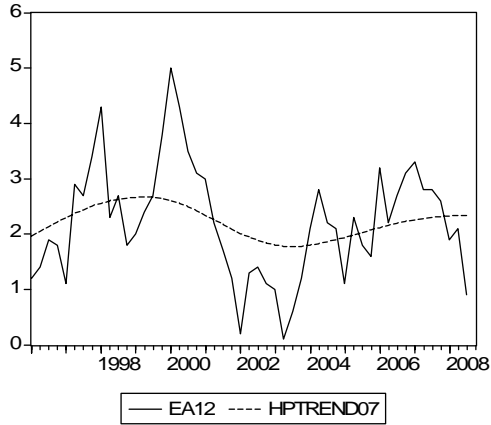|	EA12
EA12	1,00
BELGIUM	**0,84**
GERMANY	**0,95**
IRELAND	0,44
GREECE	-0,40
SPAIN	**0,65**
France	**0,86**
ITALY	**0,85**
Luxembourg	**0,59**
NETHERLANDS	**0,87**
AUSTRIA	**0,70**
FINLAND	**0,85**
SWEDEN	**0,68**
DENMARK	**0,69**

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**
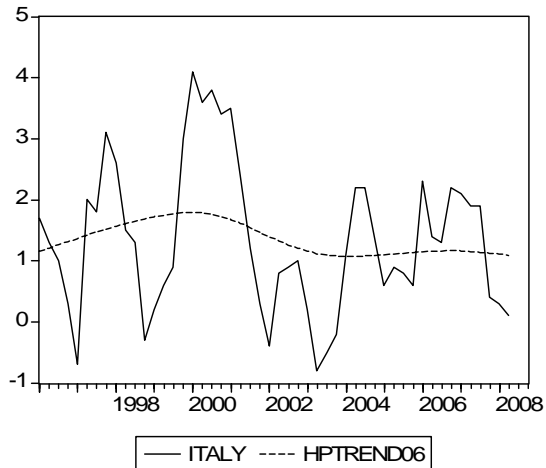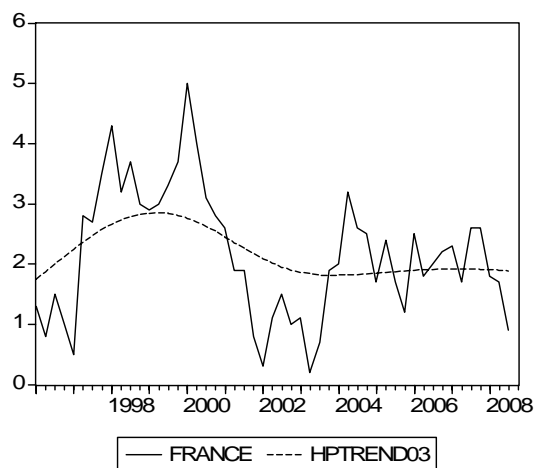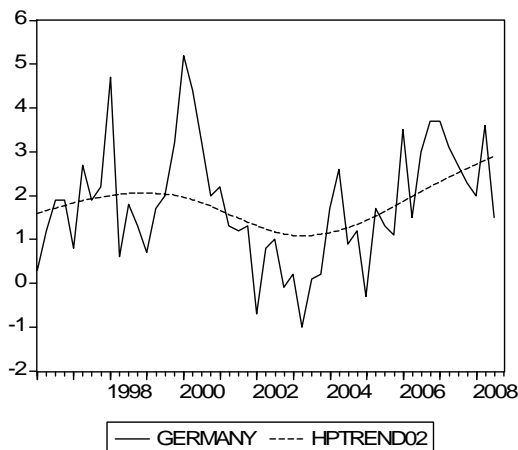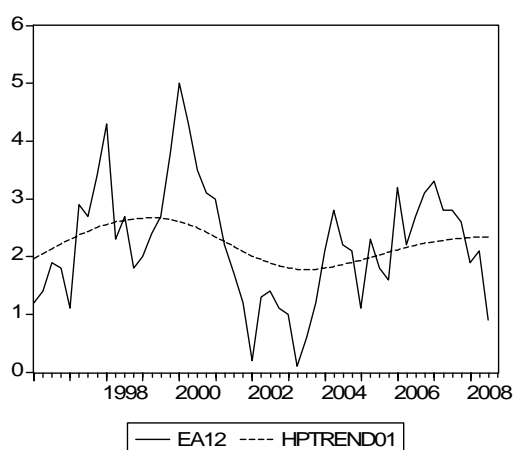
- **Correlation analysis between initial Euro area (12) and NMS, 1996-2008 :**

	EA12	CZECH	CYPRUS	LATVIA	POLAND	SLOVENIA	SLOVAKIA	**TURKEY**
EA12	1,00	0,35	**0,76**	0,24	**0,52**	**0,64**	-0,10	0,21
BULGARIA	0,18	**0,52**	0,01	0,38	0,30	0,38	0,40	0,32
CZECH	0,35	1,00	0,46	**0,77**	**0,59**	**0,58**	**0,56**	**0,50**
ESTONIA	0,40	0,35	0,29	0,47	0,12	0,17	0,09	0,35
CYPRUS	**0,76**	0,46	1,00	0,29	0,40	0,49	-0,01	0,12
LATVIA	0,24	**0,77**	0,29	1,00	0,31	0,47	**0,64**	0,30
LITHUANIA	-0,41	0,14	-0,46	0,28	0,21	-0,08	0,33	0,06
HUNGARY	0,30	-0,14	0,17	-0,17	0,08	-0,13	-0,56	0,23
POLAND	**0,52**	**0,59**	0,40	0,31	1,00	**0,58**	0,12	0,45
ROMANIA	0,14	0,13	0,19	0,11	0,32	0,41	0,09	-0,04
SLOVENIA	**0,64**	**0,58**	0,49	0,47	**0,58**	1,00	0,40	0,22
SLOVAKIA	-0,10	**0,56**	-0,01	**0,64**	0,12	0,40	1,00	0,00
CROATIA	-0,34	0,11	-0,43	0,30	0,19	0,29	0,44	-0,03
TURKEY	0,21	**0,50**	0,12	0,30	0,45	0,22	0,00	1,00

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS, <u>1996-2008.</u>**
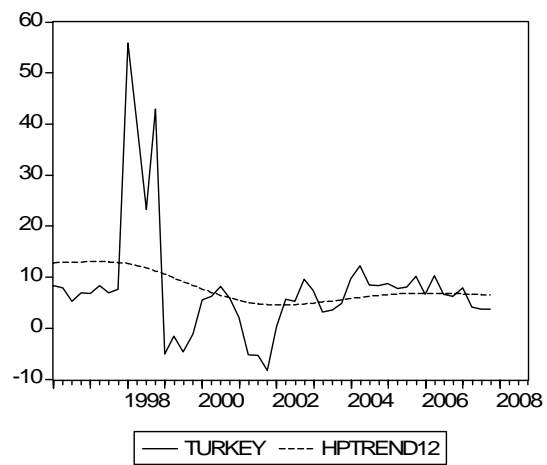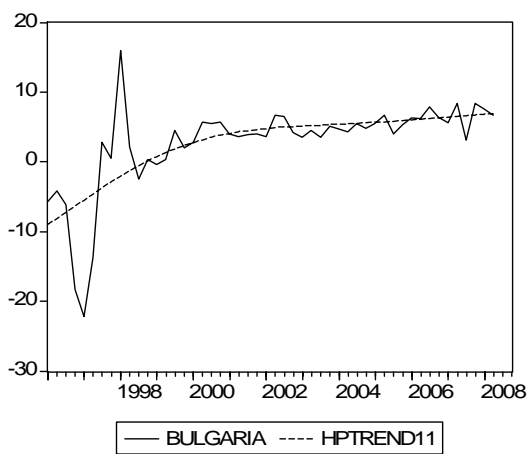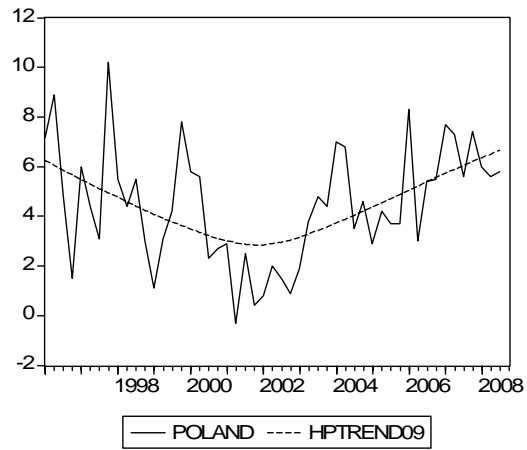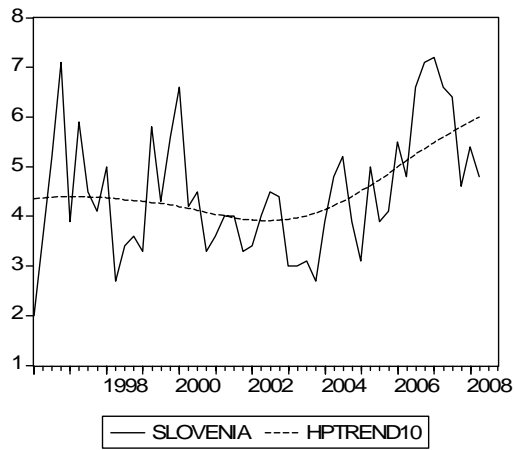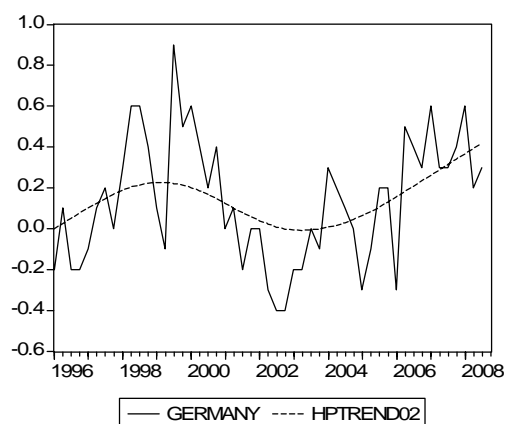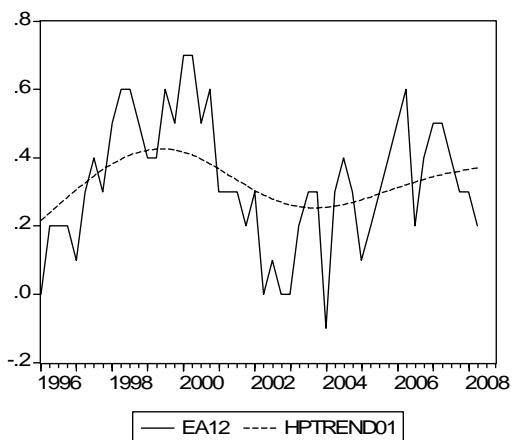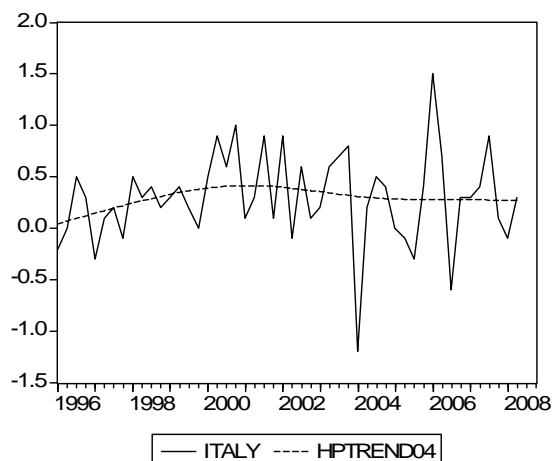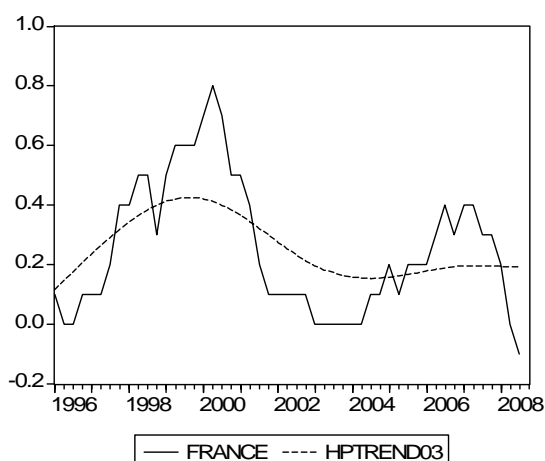
Appendice V : Rate of growth of employment.

- **Correlation analysis inside euro area (12) :**

	EA12
EA12	1,00
BELGIUM	**0,60**
GERMANY	**0,67**
IRELAND	**0,51**
SPAIN	**0,53**
FRANCE	**0,74**
ITALY	**0,51**
LUXEMBOURG	**0,71**
NETHERLANDS	**0,61**
AUSTRIA	0,14
FINLAND	0,37
DENMARK	0,24

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**

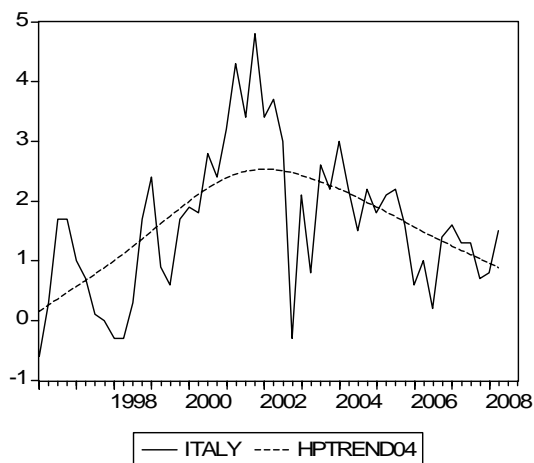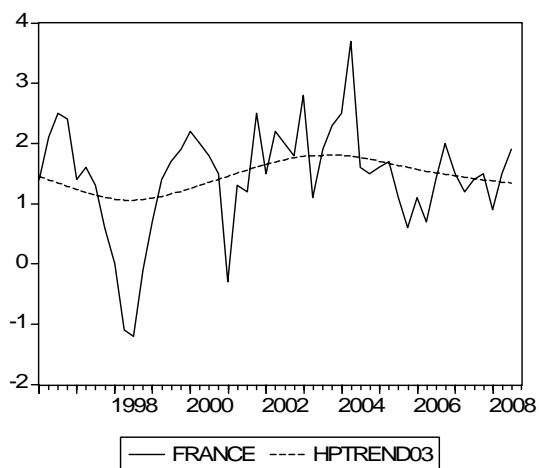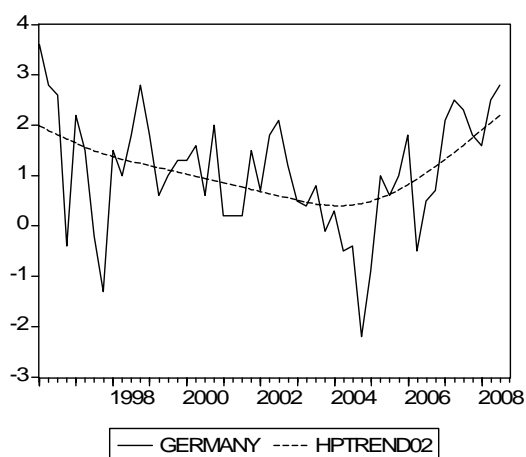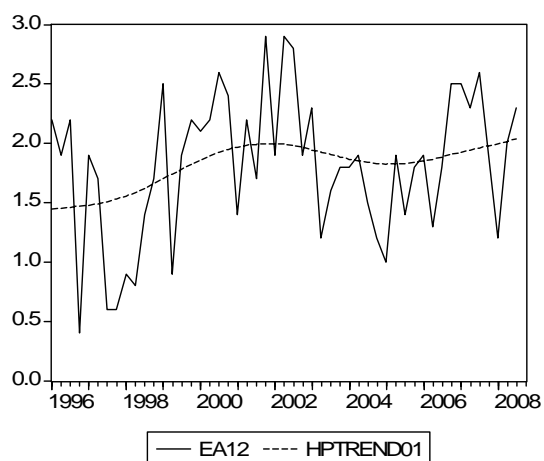- **Correlation analysis between euro area and NMS, 1999-2008 :**

	EA12	CZECH	ESTONIA	LATVIA	LITHUANIA	SLOVENIA	SLOVAKIA
EA12	1,00	-0,05	-0,07	-0,24	-0,18	0,41	-0,08
CZECH	-0,05	1,00	0,37	0,23	0,16	0,12	0,39
ESTONIA	-0,07	0,37	1,00	0,28	0,27	-0,02	0,04
LATVIA	-0,24	0,23	0,28	1,00	0,17	0,03	0,01
LITHUANIA	-0,18	0,16	0,27	0,17	1,00	0,03	0,14
SLOVENIA	0,41	0,12	-0,02	0,03	0,03	1,00	0,03
SLOVAKIA	-0,08	0,39	0,04	0,01	0,14	0,03	1,00

Appendice VI : Rate of growth of final administration spending.

- **Correlation analysis inside euro area (12) :**

	EA12
EA12	1,00
BELGIUM	0,39
GERMANY	**0,63**
IRELAND	0,45
GREECE	0,41
SPAIN	0,24
FRANCE	0,42
ITALY	0,34
LUXEMBOURG	0,03
NETHERLANDS	0,30
AUSTRIA	-0,04
FINLAND	0,01
SWEDEN	**0,66**
DENMARK	0,44

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**

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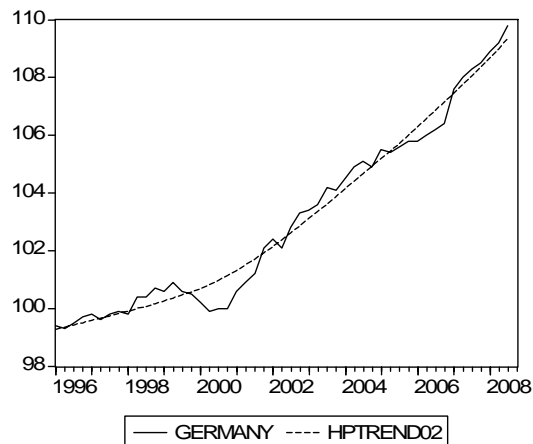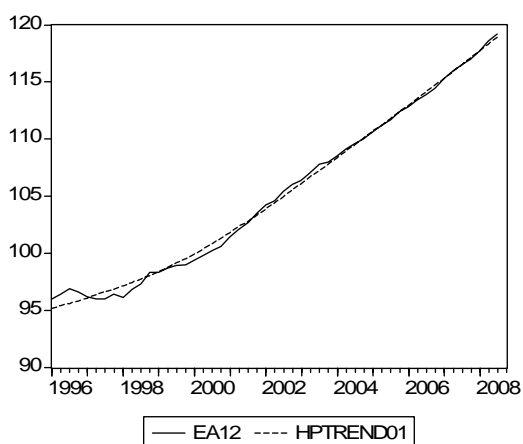- **Correlation analysis between euro area (12) and NMS, 1999-2008 :**

	EA12
EA12	1,00
BULGARIA	0,10
CZECH	0,12
ESTONIA	0,00
CYPRUS	0,08
LATVIA	-0,22
LITHUANIA	-0,06
HUNGARY	-0,11
POLAND	-0,06
ROMANIA	0,12
SLOVENIA	-0,20
SLOVAKIA	0,09
CROATIA	0,18
TURKEY	-0,05

Appendice VII : GDP deflator.

- **Correlation Analysis within initial Euro area (12) :**

|	EA12
EA12	1,00
BELGIUM	0,99
GERMANY	0,99
GREECE	1,00
SPAIN	1,00
FRANCE	1,00
ITALY	1,00
LUXEMBOURG	0,98
NETHERLANDS	0,98
AUSTRIA	0,99
FINLAND	0,93
DENMARK	0,99

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **between Euro area and NMS :**

- **Correlation analysis between initial Euro area (12) and NMS, 1999-2008 :**

	EA12
EA12	1,00
CZECH	0,92
ESTONIA	0,98
CYPRUS	0,99
LATVIA	0,95
LITHUANIA	0,84
HUNGARY	0,96
POLAND	0,91
SLOVENIA	0,97
SLOVAKIA	0,97

- **Graphical analysis of business cycle (**The business cycles method of Hodrick and Prescott filter) **of Euro area and NMS :**
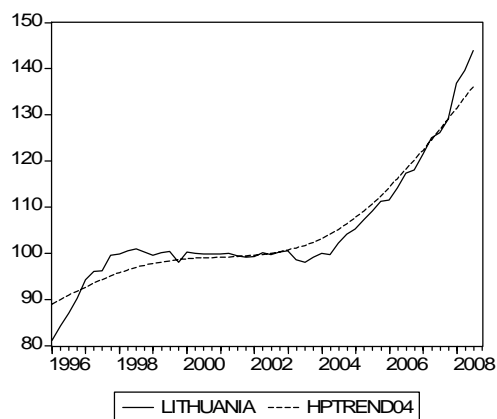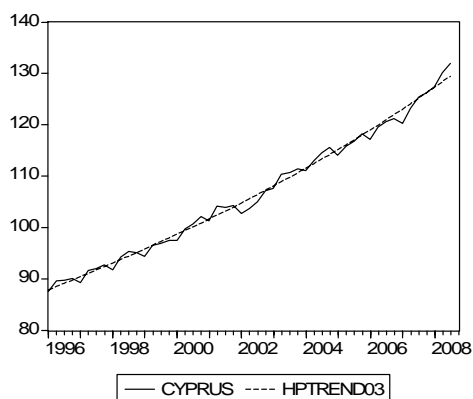
Appendice VII : Hodrick-Prescott Filter.

This is a smoothing method that is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. The method was first used in a working paper (circulated in the early 1980's and published in 1997) by Hodrick and Prescott to analyze postwar U.S. business cycles.

Technically, the Hodrick-Prescott (HP) filter is a two-sided linear filter that computes the smoothed series "s" of "y" by minimizing the variance of "y" around "s", subject to a penalty that constrains the second difference of "s". That is, the HP filter chooses "s" to minimize:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} ((s_{t+1} - s_t) - (s_t - s_{t-1}))^2 .$$

The penalty parameter λ controls the smoothness of the series σ. The larger the λ, the smoother the σ. As $\lambda = \infty$, "s" approaches a linear trend.

Hodrick and Prescott advise that, for quarterly data, a value of $\lambda = 1600$ is reasonable.